

**Phase 1 Palaeontological Impact Assessment of the
proposed construction of the Needs Camp / Potsdam
Bridge and Access Road, (near East London), BCMM,
Eastern Cape, South Africa.**



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Executive Summary

A Phase 1 Palaeontological Impact Assessment was carried out for the proposed construction of the Needs Camp / Potsdam Bridge and Access Road development, situated near East London, BCMM, Eastern Cape, South Africa. Construction (excavation) activities resulting from the proposed development, will impact on potentially fossil-bearing Adelaide Subgroup strata on both sides of the Buffalo River. Potential palaeontological impact will be considered high should excavations extend into fresh mudrock sequences. In terms of benefits and dis-benefits, fossil discoveries resulting from excavation activities into *in situ* sedimentary bedrock during the development can actually contribute to potentially exciting new discoveries. Given the scope of the proposed road building technique (block paving), it is expected that impact on underlying sedimentary bedrock will be low. Potential impact on intact sedimentary bedrock resulting from the proposed bridge construction is expected to be high. It is advised that monitoring of freshly exposed bedrock and alluvial sediments by a heritage specialist is included into the overall management plan of the project during construction phase of the bridge. It is important to note that the removal of newly discovered fossil material will require a palaeontological collection permit from the relevant heritage management authority. It is also advised that any palaeontological material found during the course of excavation activities should be reported immediately to the relevant heritage resource agency (ECPHRA).

Table of Contents

Executive Summary	2
Introduction.....	4
Terms of Reference.....	4
Methodology	5
Description of the Affected Area	5
Locality data.....	5
Geology.....	5
Background	6
Results of Survey	7
Impact Statement and Recommendation	7
References.....	8
Tables and Figures	10

Introduction

A Phase 1 Palaeontological Impact Assessment was carried out for the proposed construction of the Needs Camp / Potsdam Bridge and Access Road development, situated near East London, BCMM, Eastern Cape, South Africa (**Fig. 1**). The development comprises the construction of an 80m bridge across the Buffalo River and an approximate 3km access road, linking the Needs Camp and Potsdam villages. The new access road will connect to existing gravel roads on either side of the river and existing gravel access roads will be upgraded to block paved surface standard (lane width – 3.4m; carriageway width – 7.4km and interlocking block paved sidewalk, 1.8m wide).

Terms of Reference

Terms of Reference (ToR) for the Phase 1 PIA are summarized as follows (Terreco 2014):

- To undertake a basic Phase 1 PIA to meet the Eastern Cape Provincial Heritage Resources Authority's (EC PHRA) requirements for the proposal, including:
- Describe the existing area to be directly affected by the proposal in terms of its palaeontological heritage resources;
- Describe the likely scope, scale and significance of impacts on palaeontological, heritage resources associated with the proposal, construction and operational phases of the development, including benefits and dis-benefits;
- Make recommendations on the scope of any mitigation measures that may be applied during construction to avoid / reduce the significance of identified construction related impacts. Mitigation measures may include design recommendations as well as operational controls, monitoring programmes, management procedures and the like;
- Identify rehabilitation measures that can be reasonably applied with completion of the construction works;
- Describe implications of a 'No-Go' option where proposals are not established;

- To broadly comment on the cumulative impact of the development with respect to the palaeontological landscapes that will be affected; and
- To confirm if there are any 'Fatal Flaws' to the establishment of the project proposal with reference to palaeontological resources.

Methodology

The palaeontological significance of the affected area was evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. This was followed by a field assessment by means of a pedestrian survey. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant palaeontological information, aerial photographs (incl. Google Earth) and site records were consulted and integrated with data acquired during the on-site inspection.

Description of the Affected Area

Locality data

The study area (S32°59'05.5"; E27°39'02.1") is located in relatively high-relief terrain that is dissected by the Buffalo River between the villages of Potsdam and Needs Camp (**Fig. 2**).

Geology

The geology of the East London area has been described by Johnson and Keyser (1974). The present-day geomorphology of the landscape in the region forms part of the African Erosion Surface, and is the result of prolonged erosion and weathering that occurred throughout the subcontinent since the late Jurassic (145 Ma) until the end of the early Miocene around 15 Ma ago (Partridge and Maud, 1987). Post-Cretaceous epeirogenic events caused warping and periodic seaward tilting of the coastal belt and extensive planation from the coast inland, in time resulted in the exposure of the Cape Fold Mountains as well as the creation of the Great Escarpment and the Coastal Platform. The tectonic overprint of the Cape Folding Event and the creation of the African Land Surface in the region have in many cases been detrimental to the preservation of fossils in the underlying rocks.

Sedimentary bedrock in the area is primarily represented by late Permian Adelaide Subgroup rocks (Middleton Formation), made up of fine-grained, cross-bedded sandstone and grey to reddish, poorly stratified mudstones. Extensive Jurassic-age dolerite intrusions, in the form of dykes and sills are exposed south of the river and largely underlie the Needs Camp village (**Fig. 3**). Dolerites are not fossiliferous and can be excluded from further palaeontological consideration. Superficial deposits in the residential areas of Potsdam and Needs Camp are made up of geologically recent residual soils as well as valley sediments and well-developed alluvial deposits flanking the Buffalo River.

Background

Biozone boundaries are uncertain in the region, but the Middleton Formation (approximate equivalent of the Teekloof Formation) is biostratigraphically subdivided to include diverse terrestrial and freshwater tetrapods of the *Cistecephalus Assemblage Zone (AZ)* and *Dicynodon AZ* (Rubidge 1995). These zones are characterized by a varying suite of therapsid fossils mainly represented by the presence of *Cistecephalus*, *Aulacephalodon* and *Oudenodon* in the former and the first appearance of *Dicynodon lacerticeps* in the latter.

Historically, the East Londen area has yielded very few vertebrate fossils. Poorly preserved reptile remains have previously been recovered from several localities believed to be along the western bank of the Buffalo River mouth as well as near Morgan Bay (Mountain 1974).

Designated the Igoda Formation, four outcrops of Late Cretaceous rocks are confined to a series of small isolated limestone and limey clays deposits at the Needs Camp upper and lower quarries located near the Needs Camp village (**Fig. 4 & 5**); and at the Igoda River mouth and a nearby road cutting close to the estuary. Declared as provincial heritage sites, the historical Upper and Lower Needs Camp quarries have previously yielded macro- and microfossils, including foramenifera, ostracods, polyzoans and echinoid spines. Analysis of these outcrops suggest a late Cretaceous age, while studies of recrystallized Eocene limestones of the Needs Camp upper quarry also indicate a presence of typical Eocene foraminifera, comparable with those of Pato's Kop, which is an outcrop sited further west near Peddie. Near the coastline Adelaide Subgroup sediments are capped by Quaternary age, calcareous Nahoon Formation sandstones (*Qn*, Algoa Group) (Le Roux 1989). Three

hominid footprints preserved as casts were found in 1964 in Nahoon Formation aeolianites near Bats Cave. In addition, shell fragments and foraminifera are common in the Nahoon Formation and fossil bone fragments have been observed in Nahoon Formation aeolinities at Black Rock and Kasuka between East London and Port Alfred. Quaternary alluvial deposits can also be highly fossiliferous in places that are directly related to fluvial environments along major river courses (e.g. Buffalo River). There are currently no records of late Palaeozoic or Quaternary palaeontological exposures in the immediate vicinity of the study area.

Results of Survey

The study area is divided into 4 sections (**Fig. 6**). Section 1 and 4 are underlain by Adelaide Subgroup sedimentary bedrock capped by geologically recent sheetwash deposits (**Fig. 7**). Very little outcrop is visible in Section 2, which covers a large floodplain area of the Buffalo River. The floodplain is capped by extensive alluvial deposits and overbank deposits associated with the river (**Fig. 8**). A foot survey of the terrain revealed no evidence for the accumulation and preservation of intact fossil material within the superficial Quaternary sediments flanking the river banks in Section 3.

Impact Statement and Recommendation

Construction (excavation) activities resulting from the proposed development, will impact on potentially fossil-bearing Adelaide Subgroup strata in Sections 1, 3 and 4. While no fossil remains were recorded during a foot survey of the sedimentary exposures, potential palaeontological impact will be considered high should excavations extend into fresh mudrock sequences. In terms of benefits and dis-benefits, fossil discoveries resulting from excavation activities into *in situ* sedimentary bedrock during the development can actually contribute to potentially exciting new discoveries. However, damage to, or loss of fossils due to inadequate mitigation would be a highly negative palaeontological impact.

Given the scope of the proposed road building technique (block paving), it is expected that impact on underlying sedimentary bedrock will be low. Potential impact on intact sedimentary bedrock resulting from the proposed bridge construction is expected to be high. It is advised that monitoring of freshly exposed bedrock and alluvial sediments by a heritage specialist is included into the overall management plan of the

project during construction phase of the bridge. No “no-go” areas were identified within the demarcated footprint.

It is important to note that the removal of newly discovered fossil material will require a palaeontological collection permit from the relevant heritage management authority. It is also advised that any palaeontological material found during the course of excavation activities should be reported immediately to the relevant heritage resource agency (ECPHRA).

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Tables and Figures

Table 1. Summary of Impacts (see **Fig. 6**).

Study Area	Scope	Extent	Palaeontological significance	Stratum	Significance of Impact	Mitigation
Section 1	Block - paved surface road	Permanent	High	Adelaide Subgroup (Beaufort Group, Karoo Supergroup)	Low-Moderate	Monitoring by heritage specialist if fresh bedrock are exposed during construction phase of road
Section 2	Block - paved surface road	Permanent	Low	Superficial deposits, alluvium	Low	None
Section 3	Bridge	Permanent	High	Adelaide Subgroup (Beaufort Group, Karoo Supergroup)	High	Monitoring of freshly exposed bedrock and alluvial sediments by heritage specialist during construction phase of bridge.
Section 4	Block - paved surface road	High	Low	Adelaide Subgroup (Beaufort Group, Karoo Supergroup)	Low-Moderate	Monitoring by heritage specialist if fresh bedrock are exposed during construction phase of road.



Figure 1. Location of the study area near Potsdam and Needs Camp (portion of 1:50 000 scale topographic map 3227 DC Berlin).



Figure 2 Aerial view of the study area.



Figure 3. Dolerite intrusions are exposed south of the river and largely underlie the Needs Camp village.

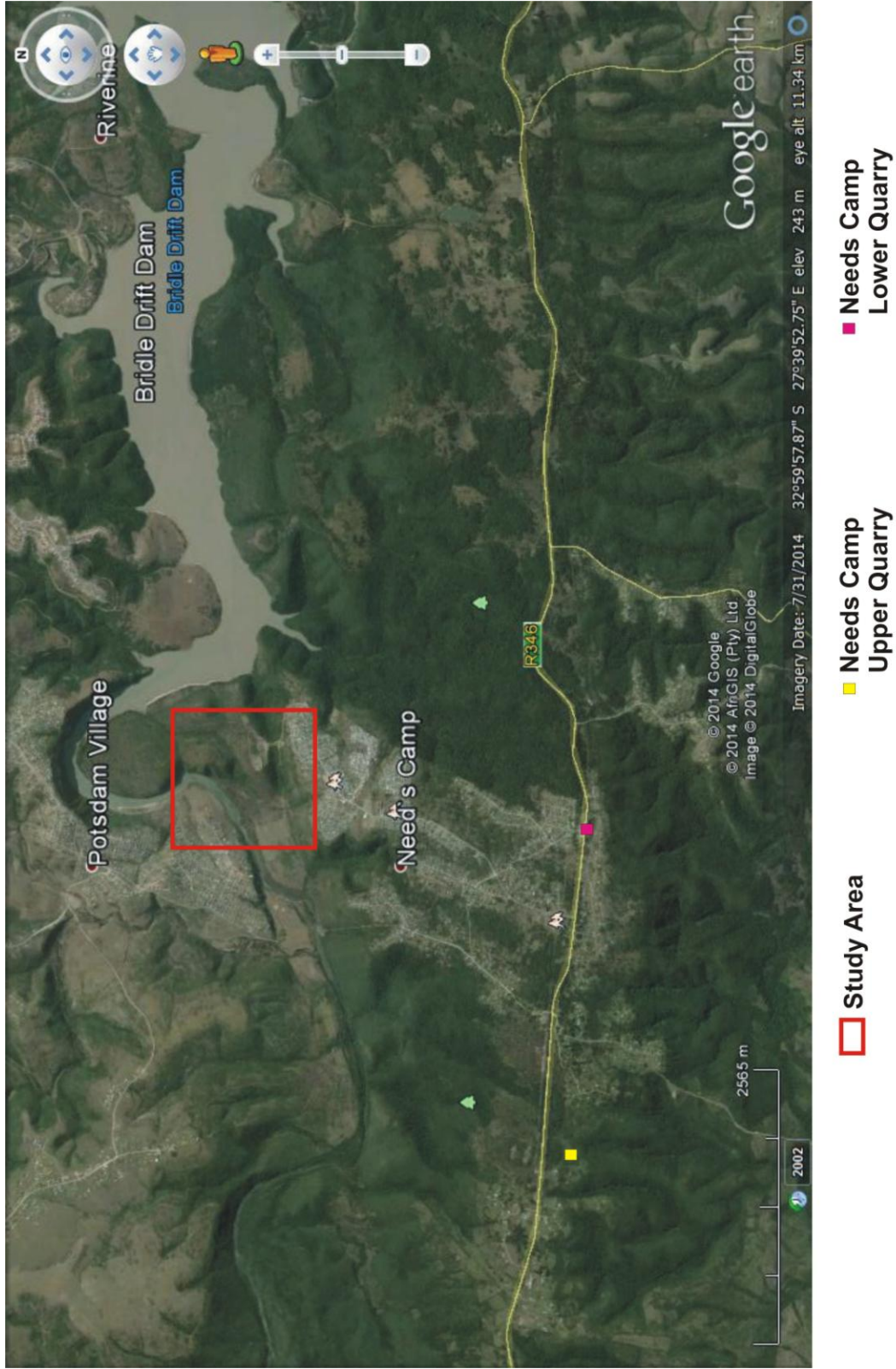


Figure 4. Location of the Upper and Lower Needs Camp quarries in relation to study area.

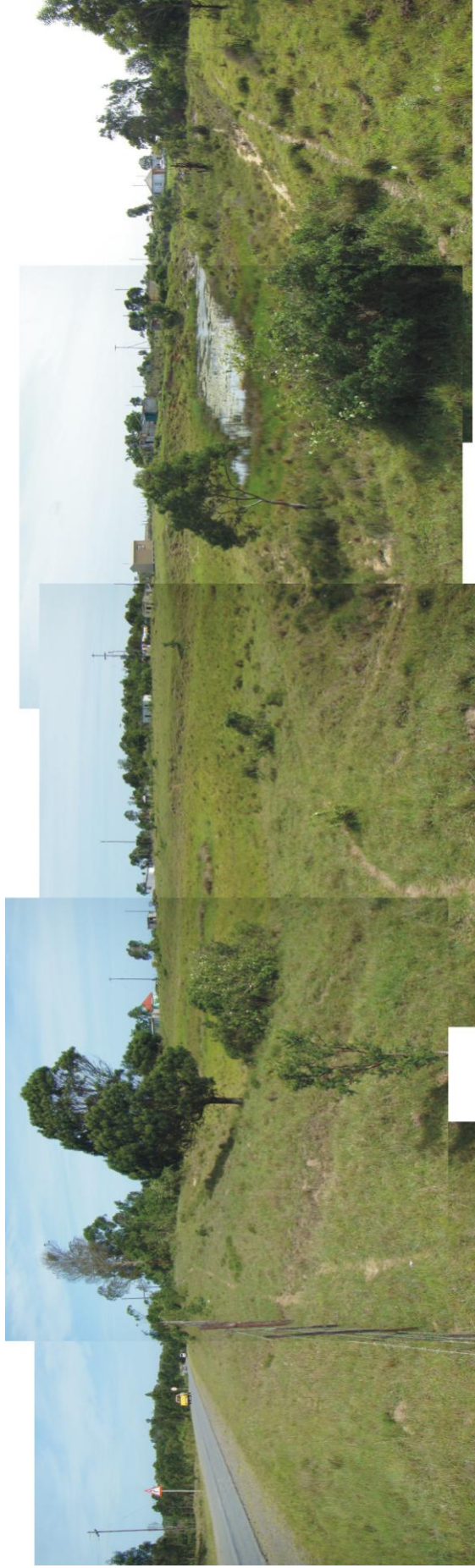


Figure 5. Old excavations at the Lower Needs Camp quarry. The deposits lies on dolerite bedrock.

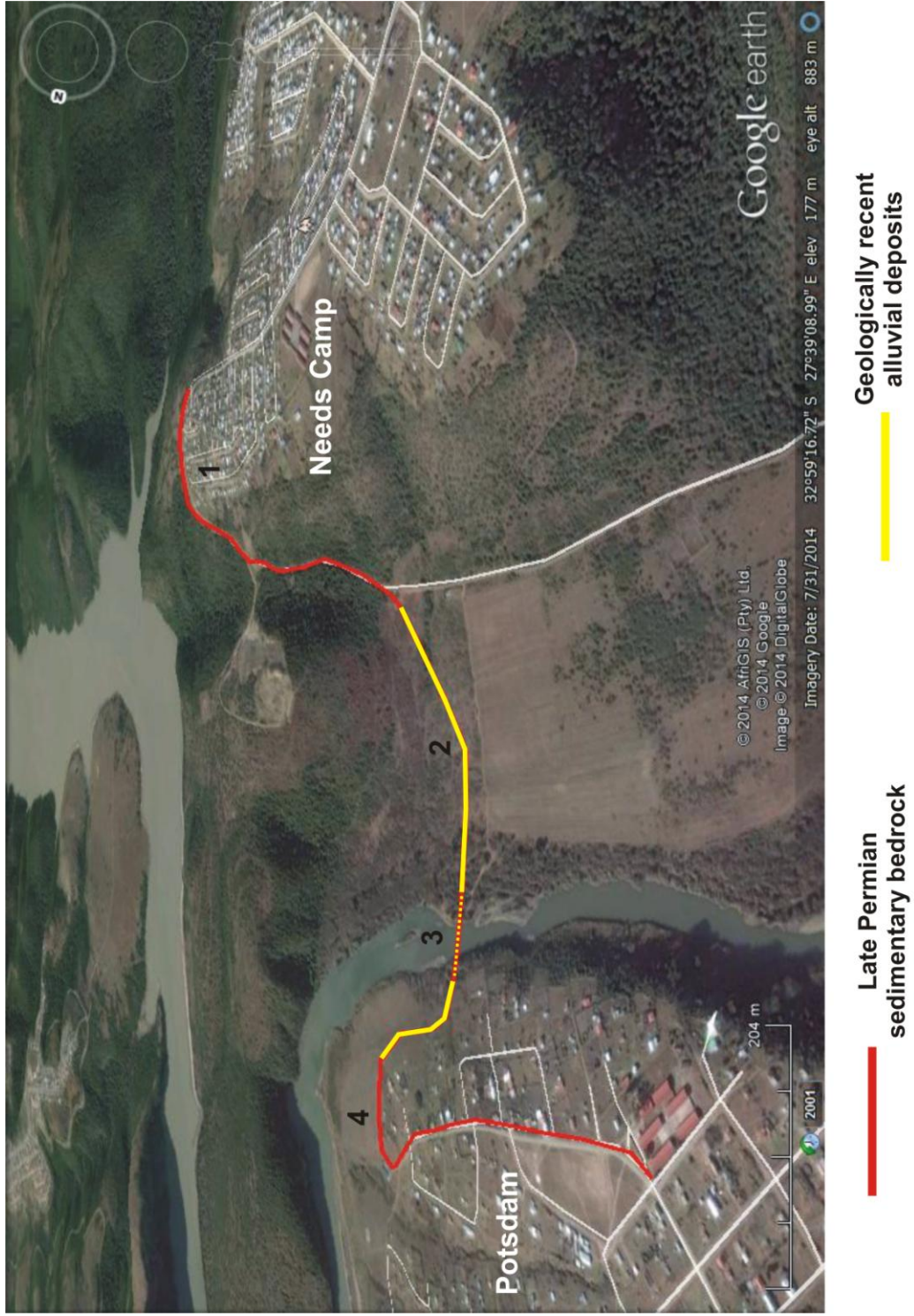


Figure 6. Aerial view of the study area, looking east.



Figure 7. Section 1: Adelaide Subgroup outcrop and associated metasediments from a possible contact metamorphic zone in close proximity.



Figure 8. View of the floodplain looking north towards the Buffalo River (above) and geologically recent overbank deposits at the river (below).